

NOTES ON THE GEOLOGY OF THE DRAKENSBERGEN, NATAL.

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WITH PLATES VII., VIII., IX.

THE Natal side of the Drakensbergen has not been much visited by geologists, and the following notes, the results of visits made in May, 1895, and September and October, 1896, are given as a small contribution to the knowledge of one of the most interesting and beautiful regions of South Africa.

The tours embraced the Giant's Castle, the valley of the Little Tugela and foot of the Champagne Castle, and the Tugela Falls, at Mont aux Sources ; also the Bushman Caves and Bushman's Pass at the source of the Bushman's River.

The features of this portion of the Drakensbergen are everywhere the same, and the immediate neighbourhood of the Tugela Falls may be described as showing the typical scenery and geological structure. This district is more accessible by waggon than any of the other localities, and the scenery is, on the whole, more beautiful.

In travelling from the nearest railway station at Ennersdale, the Tugela is first crossed where the new magistracy buildings are now being erected. Here the country is open, and for Natal it would be considered very flat, though in reality it is undulating and is dotted here and there with isolated conical or flat-topped hills. By aneroid measurement * the drift lies 3,550 ft. above sea-level.

The rocks are like those around Dundee and Newcastle—light-coloured sandstones and shales, belonging to the Molteno beds of the Upper Karroo series. Coal has not yet been found in this neighbourhood, though it occurs in many places towards the Orange Free

* The altitudes throughout are from aneroid readings. Owing to an accident to the thermometer, temperature corrections could not be made ; but in cases where comparison is possible I have not found much discrepancy.

State and Transvaal borders. The shales of the series show good examples of ripple-marking.

A day's waggon trek * further on, just beyond the old magistracy known as Allison's, we come to the first of the mountains or spurs of the Drakensberg. These, together with several isolated high hills, mostly flat-topped, are the remains of the extensive plateau from which the Berg itself rises so precipitously. All these spurs are therefore alike in their main features. Such variations as do occur are due to the different thickness of the various beds of the cave sandstone and the softer beds below the line of cliffs, and the amount of weathering to which these have been subjected.

These remains of the plateau owe their preservation to a protecting sheet of dolerite, similar in appearance to the cappings found on all the higher mountains of the Free State, such as Plaatberg, Pilani, Majuba, &c. In no case is this sheet of dolerite above the cave sandstone lower than from 5,900 ft. to 6,100 ft. above sea-level on the Natal spurs of the Berg,† although dykes may occur at lower levels. Wherever the sheet has disappeared through erosion (or did not exist originally) the mountain or spur has been much lowered, and is evidently undergoing faster weathering.

The dolerite capping always rests on a thick, solid bed of cave sandstone. After I had become familiar with the usual appearance of this dolerite seen from a little distance, and the form its characteristic mode of weathering gives to the tops of the hills and ridges, I could tell miles away whether or not it would be found on the summit of certain hills.

Whereas in the Free State portion of the Berg the dolerite capping often shows a decided columnar structure, I found no indication of columnar jointing in the part of the Berg under notice. It is, in fact, seldom that a cliff-face can be met with in the dolerite. Steep grassy slopes, and rounded hillocks and ridges covered with weathered boulders of the dolerite, are the main features, and present a marked contrast to the cliff tendency of the cave sandstone below. As the Berg is approached one notices a strange sameness in the formation of this upper part, or capping, of the spur ridges. They all rise in terraces, and seen end on, many look like a succession of camel backs.

In the cañons of the Tugela and Little Tugela, close up to the main wall of the Berg, cliff faces in the dolerite are exposed. In one place on the Little Tugela nearly 400 ft. of perpendicular

* A day's waggon trek in Natal is about twenty miles.

† The Drakensbergen are known locally as "The Berg."

dolerite cliff can be seen forming the sides of the cañon, which there has a depth of 2,000 ft. (aneroid measurement). In this and the few other places where it can be well seen in section, the dolerite appears to lie as flat as the sandstone on which it rests. Measured from the sandstone floor to where the first bed of amygdaloid covers it, the dolerite in the Tugela district does not average more than 500 ft. in thickness, but at the Bushman's Pass and Giant's Castle end it is thicker—about 700 ft. The greater the distance of the dolerite from the Berg and the covering amygdaloid, the thinner it is. Ten miles from the mountains it is only a few feet thick, and at greater distances it has been entirely removed, but there can be no doubt that its extent was formerly enormous.

The lowest portion of the dolerite sheet contains a great quantity of agates, calcedony, crystals, and numerous other forms of quartz,* similar to the pebbles found in the Vaal River near Kimberley, together with occasional quartz veins. I saw these in the dolerite near the Berg only, but not on the ridges over four or five miles distant. But on the spurs two or three miles away the ground is covered with them at and below the level where they occur. At one place I noticed similar pebbles in the sandstone below, just at the point of contact where it has been altered into a quartzite. This alteration is but skin deep, however, extending to little more than eighteen inches or two feet.

There are a number of large dykes of this same dolerite running nearly parallel to each other near the Bushman caves, and these can be easily followed from ridge to ridge for miles. At the Mont aux Sources end of the range they are not so regular, but still very numerous. These may now fill up the fissures through which the dolerite sheet was erupted. In these dykes no agates were noticed.

In conclusion, I estimate the remains of this sheet to extend in Natal in scattered, uneroded survivals over an area sixty miles by fifteen at least. How far it may extend beyond Giant's Castle in the direction of Cape Colony I do not know. The foregoing description is the result of observations made during thirteen different ascents of the mountains or spurs, the larger number being in the Bushman's River Pass and Giant's Castle district.

The cave sandstone, which lies below the great dolerite sheet, is a compact, hard, gritty rock, weathering with a rough surface, which

* I did not, although on the look out for them at Pilani, Orange Free State, notice these agates, &c., in the dolerite, but at Harrismith I remember an alluvial deposit of them on the flats 1,800 ft. below the level of the top of Plaatberg.

proves a safe foothold in climbing. It is usually cream or white, sometimes light red in colour, and being compact and fairly uniform in texture, it either breaks away in huge masses, leaving cliffs with very straight walls, or it projects beyond the softer beds below. An overhang of 20 ft. is very common, the mass being occasionally from 100 ft. to 150 ft. and in a few cases even over 200 ft. thick, with no signs of breaking away. In the Bushman's River district the overhang is often greater than 30 ft., and in one place it is over 60 ft., but there the lower portions have fallen in, leaving a comparatively thin roof.

This upper series of sandstone is a good geological landmark along the whole sixty miles from Giant's Castle to Mont aux Sources, while the cliffs formed of it are the most striking feature in the scenery of the spurs. It varies in thickness from 200 ft. to 600 ft., the top of it always being from 5,900 ft. to 6,100 ft. above sea-level. As far as I could judge from scores of sections, it is quite horizontal. At Tabaimhlope the sandstone must be over 800 ft. thick at the south end. I found no fossils, but noticed a few round, hard sandstone nodules, often containing a little pyrites such as one finds in the sandstones used for building in the Free State. The huge masses of sandstone that have broken off and lie scattered over the mountain slopes add much to the effectiveness of the valley scenery among the spurs.

Below the thick mass of sandstone are two beds with marked characteristics, forming the walls of the so-called caves. The upper is rather a friable, light-coloured, marly sandstone, which weathers so that it frequently looks like a row of barrels on end, or a series of stunted columns. It is not a thick bed, being seldom more than 6 to 10 ft. I found it associated with the cave sandstone in the Free State as well as at the various caves of the Bushman's River system, but it was not developed in quite so marked a way as at Tugela. It rests on a bed of nodular sandstone from 5 to 15 ft. thick, varying in different localities. This rock I found at Pilani, in the Orange Free State, in the same relative position. Below is a deep, pink, earthy layer 2 or 3 ft. thick. Where exposed, eland and cattle tracks lead to it from several directions; the animals go to lick the rock.

Below this comes another layer of sandstone similar to that of the cliffs above but not so thick; it forms cliffs and escarpments of less importance.

The remainder of the slopes down to the bottom of the valley is much covered with vegetation; but there are numerous sandstone

outcrops and the streams and dongas expose the intervening shales, but the sandstone beds predominate. These lower sandstones differ from the cave sandstone in being softer, usually micaceous, and often inclined to be shaly. In fact, they are more like the sandstones of the coal areas, and probably represent the upper portion of the Molteno beds.

Considering the several beds of the compact sandstone with their intervening softer beds as forming the series called the Cave Sandstone, this formation may be put down as from 1,000 to 1,200 ft. thick.

I did not find the bone-breccia referred to by Mr. David Draper in his paper (*Quarterly Journal of the Geological Society*, November, 1894, p. 551), though I was constantly on the look-out for it.

The cave floors consist of earth, dust, ashes, eland and cattle droppings, and rocks—fragments and boulders. In this debris Mr. M. S. Evans found many rude Bushman implements made of the chert, agate, and dolerite, previously described. They are mostly spear and arrow heads and skin scrapers. These, except some given to the Durban Museum, have been sent to Professor Boyd Dawkins.

From reading Draper's paper I expected to find that the great wall of the Drakensbergen which we were approaching consisted of sedimentary strata capped by a thousand feet of amygdaloid traps, and the lines of escarpment running parallel and horizontal above each other for miles, and the straight base line of the final cliffs seemed entirely to confirm this idea. It was, therefore, quite a surprise to find nothing but amygdaloidal rock from the top of the mountain right down to below where one leaves one's horses to begin climbing; that is to say, right down to the dolerite flats forming the plateau at 6,500 ft. above sea-level. These parallel minor cliffs and escarpments, however, turned out to be quite the same as the huge main walls. Thus the whole main range consists of amygdaloidal lavas of a vertical thickness of 2,500 ft. at Bushman's Pass, the lowest part, and 4,500 ft. thick at the highest peaks such as Champagne Castle and Mont aux Sources. I may mention in passing that my observations are based on three ascents of the Bushman's Pass and the ascent of the peaks on either side of it, one ascent to the top of Giant's Castle, and various visits to the lower slopes, namely, at the foot of a large peak between the Pass and Giant's Castle, the foot of Champagne Castle and the foot of Mont aux Sources in two places, and the top of the ridge above Koodoo Pass to Witzie's Hoek. This makes seven different places where I

reached the amygdaloid, and everywhere the conditions were found to be the same, though at Bushman's Pass district the aneroid always recorded 6,700 ft., where they were first met, as against 6,500 ft. elsewhere. I was quite unprepared to find so great a mass of volcanic rock, and equally surprised to see no disturbance of the sandstone below.

At the foot of the Tugela Falls the scenery is, in some respects, like that of the Dolomites not far from Innichen in the Pusterthal, below the Drei Schusterspitze. The peaks, buttresses, pinnacles, cliffs, ruined towers and spires, and rich colouring of the rocks are grand beyond description. The river cañon that has to be traversed to reach the foot of the falls is most interesting and beautiful, and probably one of the unique things in South African scenery.

The top is very disappointing—a dreary, forsaken wilderness of rocky hills and desolate valleys gently sloping into Basutoland, covered with grass, heather, bog, and rocks, while the distant view into Basutoland is cut off by high hills and ridges. It is, in fact, a volcanic plateau, carved into monotonous hills and valleys towards Basutoland, all the peaks, cliffs and features being on the edge overlooking Natal.

Geologically, therefore, we are not entitled to speak of the Drakensbergen as a “mountain chain,” for in reality we have here simply “mountains of denudation” on a huge scale, and their Natal face is an enormous escarpment.

At the Bushman's Pass end the plateau seems to be over four miles wide, and though the Basuto ridges cut off the view further west, one could see twenty miles along towards north and south, and there, too, it is broad on top. People who have been on top of Mont aux Sources, which is easily climbed from Witzie's Hoek, tell me it is the same there. If it is all the same right along the Griqualand frontier, then we have a plateau of about 200 miles long by more than four miles broad, or about a thousand square miles of lavas from 2,500 ft. to 4,500 ft. thick. The kaffir police say it is a day's journey broad on the top, which would be about eighteen or twenty miles; they say it is three day's hard walking from the nearest inhabited country on the Natal side to the Basutoland inhabited valleys, the plateau above 9,000 ft. being quite desolate, without any human habitation.

Even on the top I saw nothing to indicate the former existence of a crater, nor on the various ascents could I discover any ash or tuff beds, and probably, therefore, the whole of the amygdaloidal rock originated in the form of great fissure eruptions. The only rock not

like the other amygdaloids formed a narrow cliff at the head of the Giant's Castle Pass, and seemed to be a dyke of very slaty stuff, with distinct slaty cleavage.

I saw no evidence of glaciation in any of the portions which I visited.

The amygdaloids which compose this enormous plateau and cliff faces vary considerably.

The lowest have a dark, tough crystalline matrix full of milk-white striated zeolites of all sizes—from a pin's head to three inches in diameter. These occur at the top of the pass as well as at the bottom. One variety has a bright red matrix, and is the toughest and hardest rock to break of any in the Berg. I could not find it in position, but only as boulders in the gullies and streams, of which it composes about 5 per cent. Another kind is reddish brown, highly crystalline, and full of small oval zeolites, many of them transparent or very nearly so. It is a hard rock and rings to the hammer, but is not so tough as the other two, and seems to decompose more readily. When much weathered it turns a pale sage-green. In the Berg all the peaks are composed almost entirely of this rock. In places it forms square-edged walls and causeways of large, rectangular blocks that look as if they had been built by giants. It seems the most commonly occurring of all. I found cliffs near the bottom and at various places going up, as well as on top. A fourth kind exhibits a more pumice-like appearance on the outer weathered crust, the zeolites, &c., having been eroded out of the steam holes. It is a fairly tough rock inside, but the outer crust is friable. It contains but few amygdules, weathers into round masses, and peels away in rings like many of the dolerites I have seen in the railway cuttings. I noted it in many places, but never above the pass. A fifth sort differs considerably from the others; it is less crystalline, is not tough, but crumbles fairly easily into irregular nodules which are a little harder individually than the mass of which they form part. It contains quantities of white inclusions, which are rather hard and frequently stained green.

Some of these cliffs and masses of rock seem to show a rough kind of bedding with a slope downwards towards Natal, but this was not distinct.

At Champagne Castle the Drakensbergen are 7,000 ft. above the valley immediately below, and a little less at the Mont aux Sources. I have seen nothing in Europe resembling the five miles of cañon below the Tugela Falls. In places it is not more than forty feet wide, and the only route is the river-bed itself, up which four hours'

rough walking is required to reach the foot of the lowest fall. The rise is 1,200 ft. in four miles from the mouth of the gorge to the foot of the lower falls. Meyer, of the Surveyor-General's Department, made the height of the main Tugela Fall, with its three steps, to be 2,050 ft. The tunnel through which the river flows at one spot divides the lower part of the cañon into two. It is not quite dark inside, as the river reflects the light well into it, and it is hardly 150 ft. long. Of course one has to go through the water, which in one spot is chest high. All the mountain streams are crystal clear; even a freshet after a storm does not make them the least muddy. Some of the pot-holes are large and deep. In winter the frozen waterfalls, thirty or forty feet high, have a charming play of rainbow colours in the sunlight. On top of Giant's Castle one frozen pool was too solid to break either with a heavy iron-pointed alpenstock or the heaviest of rocks we could drop on to it. In sheltered spots on the top snow lies most of the winter, and frequently falls during mid-summer.

In spring the flowers are very beautiful and occur in great profusion.

EXPLANATION OF PLATES.

THE MONT AUX SOURCES.

PLATE VII.

General view of the face of the Mont running from the south-east (left hand) to the north-west tower (right hand). The Tugela Falls are seen almost in the centre of the cliff-face. This face of the Mont aux Sources is really concave, as may be observed on close examination of the plate. The many projections and ridges show up best before sunset or sunrise, and are lost in the full glare of daylight.

PLATE VIII.

The Free State watershed of the Berg. This runs off as a spur from the base of the north-west tower seen on the right of Plate VII.

PLATE IX.

View of the south-east tower. The straight escarpment lines are due to the amygdaloidal lavas.

Had the three photographs been taken from one spot they would have given a panoramic view of the Mont—Plate VII. being the centre, Plate VIII. on the right hand (N.W.), and Plate IX. on the left (S.E.).

(The Plates are from photographs by I. H. Murray, Maritzburg.)